SPIN POLARIZED CHALCOGENIDE THIN FILMS OF $CuCr_2Se_4$

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In this work, we demonstrate the successful synthesis of $CuCr_2Se_4$ thin films. Bulk $CuCr_2Se_4$ is a highly spin polarized material with a Curie temperature of 460K [1]. Electronic structure calculations indicate that the magnetic moment is primarily due to the high spin polarized Cr density of states balanced by small contributions from the Cu and Se sites with opposite magnetization. Therefore, given successful growth of $CuCr_2Se_4$ in magnetic thin film form, it would serve as an ideal electrode material for magnetic tunnel junctions. We have synthesized $CuCr_2Se_4$ films by pulsed laser deposition and varied deposition temperature, partial pressures, substrates, as well as laser energy density. Depositions from room temperature to 650°C in a vacuum or selenium atmosphere exhibit magnetism on a variety of substrates, including MgO, $MgAl_2O_4$, and $LiNbO_3$. Using a superconducting quantum interference device (SQUID) magnetometer, we have determined the magnetization value to be near the bulk value of 5 μ_B per formula unit. Atomic force microscopy reveals a topographically smooth surface with a RMS value of 0.24 nm. The Curie temperature is above 390K, the detection limit of our SQUID. X-ray magnetic circular dichroism and x-ray absorption spectroscopy have been performed on these films showing that they closely resemble those of the bulk $CuCr_2Se_4$ phase.

[1] F.K. Lotgering. Solid State Commun. 2 (1964) 55.